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ABSTRACT

The first section briefly describes a library-information network of the kind that could exist at the end of this century if the society gave it a priority not often given to knowledge and understanding. The second section suggests that what the present library-information "system" most obviously lacks and most critically needs is the analog of a nervous system -- which is to say, of course, an appropriate computer-communication network. The third section briefly describes the ARPA Network which is now coming into being, and which sharpens many of the technical concepts that must figure in a plan for a library-information network. Although the plan described in this paper is unrealistically simple it is complex in three ways: (1) it deals with an extended future; (2) it recognizes that there are several ways to proceed toward more or less the same desideratum and (3) it deals with a highly pluralistic activity and a very complex technology -- and must therefore be "read complexly" even though stated in oversimple paragraphs. (Other papers from this conference are available as LI 003360 - 003388 and LI 003390) (Author/NH)

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A Hypothetical Plan

for a Library-Information Network

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TABLE OF CONTENTS

Introduction 3

A Library-Information Network of the Distant Future 6

The Electronic Nervous System 8

The ARPA Network 10

A Library-Information Network Model for 1980 15

How to Get from Here to There 25

Some Thoughts About Initial Steps 27

Introduction

The public purpose of this paper is to formulate a plan to serve as a framework for discussion or a target for criticism. It is a plan for a network to facilitate interaction among libraries and between libraries and other parts of the universe of information and knowledge.

The private purpose of the paper -- or, better, my reason for being happy to undertake to write it -- is to give myself the pleasure of reflecting (again, after a few years of absence from the field) upon how the new technology of information might contribute to significant improvements in the preservation and organization of knowledge and in its retrieval, communication, and application. It is obvious that the technology has much more raw power to contribute than is being refined, specialized, and exploited in library and library-related applications. It is obvious that the technology is continuing to advance (in terms of raw power) at such a rate that one decade's dreams are more likely to become the next decade's missed opportunities than to become its operational systems. But it is not obvious how to get things organized to grasp and develop the opportunities presented by the burgeoning technology of information. The "pleasure of reflecting" may therefore turn into frustration as I write, but, even if it does, there is sure to be some joy in contemplating, for the library in its relation to the body of knowledge and the human intellect, such an increase in effectiveness as in the past decade the computer gave to the comptroller's office vis-a-vis the payroll and the inventory.

A simple plan is a pair of models. One model represents how the planned process will work at some future time or times. The other model is a hypothesis about how to get from now to then in such a way that the first model will then obtain. A complex plan with contingencies may involve alternates to or conditionalities within each of the two models.

The plan to be described in this paper is forced into unrealistic simplicity by the pressures of space and time. Even so, it is complex in three ways. First, it deals with an extended future, and, although it concentrates on the decade at hand, it anticipates continuation into the 1980's and 1990's when the main "payoff" will or would probably be collected. Second, it recognizes that there are several ways to proceed toward more or less the same desideratum, and therefore does involve a few alternatives and conditionalities. And, third, it deals with a highly pluralistic activity and a very complex technology -- and must therefore be "read complexly" even though stated in oversimple paragraphs.

Instead of proceeding immediately to set forth a plan, I am going to interpose three more introductory sections. I want to do so in order to make sure that we all have in mind at least a few of the technical images that are essential components of constructive thought on the present subject. The first interposed section briefly describes a library-information network of the kind that I think will exist at the end of this century -- or at least could by then be brought into existence if the society gave it a priority not often given to knowledge and

understanding. I think it is important to consider where we may be going in the longer term in order to round out the context -- presumably we know approximately where we are now -- for a five- or ten-year plan. The second interposed section suggests that what the present library-information "system" most obviously lacks and most critically needs is the analog of a nervous system -- which is to say, of course, an appropriate computer-communication network. I think that there is enough validity in that analogy to risk a quick venture into rather hazardous metaphor. The third interposed section briefly describes the ARPA Network. I think that that network, which is now coming into being, sharpens many of the technical concepts that must figure in a plan for a library-information network.

A Library-Information Network of the Distant Future

One of the difficulties of network planning at the present time stems from the fact that, while "realistic" planning is limited by external factors to a time span of five or ten years, computer-based information networks will be developing and evolving for two or three times five or ten years. Networks planned now can be no more than waystations and check points on a long road. But the road itself and where it goes are of the very greatest importance for the future of mankind. It may well be that networks planned now will be significant more because of their influence on the laying out and building of the road than because of their improvement of library and information services.

It is easier to see and describe the information networks of two or three decades hence, I think, than the course that network efforts will follow in the decade now beginning. Surely there will be a time when most serious intellectual work is done "on-line," with the aid of and in the medium of an electronic information network. Desks will be consoles. Pens and pencils will be position-sensitive styli. If paper plays a significant role, it will be because paper supports clear images that can be handled conveniently not because print on paper lasts for years. Most business and professional conversations and many meetings will involve computer support and take place through the network. Many conversations will be between a person on the one hand and the network (or a computer program in it) on the other. Memoranda, papers, books, tapes, films, data sets, and programs will be "published" by being submitted to

and accepted at some level by the network. Both public and proprietary information will exist within the network -- or within parts of it, for it will be a network of networks, continually changing in respect of detailed configuration -- and there will be elaborate (though doubtless not wholly effective) mechanisms for maintenance of privacy, security, and control of access. Libraries will not only interact with their users and one another mainly through the network but will exist mainly within the network and constitute not one, but several of its most important subsystems. Computer-based relational nets will have become more important than documents and data sets as media for the representation and organization of knowledge. There will be transformations from computer-based relational nets to natural and mathematical language and other modes of expression, and people will communicate with computer-based relational nets much as with other people.

The situation just described may well be transitory, its network of networks a waystation on the road to some knowledge system based even more heavily on "artificial intelligence." But the situation just described is not the one the present plans are intended to achieve. The present plans lead in the general direction of the situation described, but they pertain to a nearer term. They do not assume as much help from computer programs that attempt to "understand" and "organize" the body of knowledge. They rely almost exclusively on human initiative, comprehension, and control, but they depend much more upon digital computers for routine processing and digital transmission channels for communication than most of the recent plans for "national systems" have depended.

The Electronic Nervous System

The present "library system" and the present "system for scientific and technical communication" are not to any large degree the results of deliberate centralized planning, design, or organization. They are the results of evolution under the diverse influences that operate in a pluralistic society. It takes evolution a long time to create a nervous system. The systems just mentioned do not have advanced nervous systems. Perhaps they have rudimentary nerve nets: their various parts do communicate with one another in a somewhat-faster-than-chemical way. But they do not yet have ganglionic or central nervous systems. Such nervous systems are, in my judgment, the most important things for them to have if they are to "get organized" and cope successfully with the pressures and demands that are being imposed upon them by the crescendo of technology with its alarming side effects, the "information explosion," and all that.

Biological evolution apparently encountered difficulties in incorporating central nervous systems into organismic structures already operating without central nervous systems. For one thing, the best material for making nerves was on the outside, whereas the best place to put the nervous systems was inside, and it took a major revision of the animal body plan to correct the matter. Fortunately, social evolution does not face that problem. The choice material for making a library nervous system is on the outside, it is true, but that is where libraries need a nervous system: not inside but outside -- between one library and another, between each library and other parts of the overall information complex.

Biological evolution developed co-ganglionic nervous systems before it developed nervous systems on the human paradigm, with one dominant ganglion. I think that nature was wise to follow that course, but wise also to move right on to greater specialization of function and centralization of control. For the library-information organism, I advocate a multi-ganglionic system, but I think control of most of the planning and much of the research and development should be vested in a central ganglion -- or, to break away from the biological-evolution analogy just in time to fall into another one of no higher calibre, a central organization. Too many cooks spoil the soup if they all use the same pot without a recipe. On the other hand, it takes a lot of cooks to make a lot of soup. Therefore, if there are many people to feed, a choice must be made among letting them go hungry, serving them bad soup, and getting organized. In my opinion, the most important step toward getting the world of libraries and information organized is to develop for it and in it an electronic nervous system with some, but not too much, centralization of function: with strong centralization of planning, moderate centralization of research and development, and continued distribution among diverse organizations of most of the operational functions.

The ARPA Network

The most important current development in the network field, I believe, is the multicomputer network that is now a focus of research and engineering by the Advanced Research Projects Agency and about a dozen of its contractors in the field of information processing. The ARPA Network is bringing into reality many of the dreams and implementing many of the technical concepts that figure in plans for a library-information network. The multicomputer network is incorporating ideas that only recently were widely regarded as fanciful. In two or three years, enough of them will have been tested -- and, I am confident, proven -- to shift the argument from one of feasibility to one of optimization. In any event, it seems very likely that the ARPA Network will provide an existence proof for interactive multicomputer networks, and it is conceivable that the prototype network, suitably extended, will serve the library-information field as its initial electronic nervous system.

The main motive force, both technical and fiscal, behind the ARPA Network has been Lawrence G. Roberts, Director for Information Processing Techniques of the Advanced Research Projects Agency. He has recently described the over-all concept and the status of its implementation. Here I can give only a quick summary, but I want to do that, at least, because, as I say, I believe the ARPA Network is of crucial importance for library-information network planning.

At the end of its initial development phase, the ARPA Network will embrace about 25 "host" computers at about 15 locations from California to Massachusetts. At each location there will be, in addition to one or more host computers, an Interface Message Processor (IMP), a small computer modified to facilitate connection

to host computers, on the one hand, and telephone lines (or other transmission links), on the other. The IMPs will communicate with one another through 50,000-bit-per-second (50-kilobaud) lines, and with those lines (mainly leased) they will constitute a store-and-forward net responsible for delivering intact to any specified host computer, via one route or another, with retransmission if necessary, any message -- consisting of packets of bits with suitable "headers" -- presented by any host computer. The redundancy of interconnection will be such that each node will have at least two, and usually three, avenues into the network -- and that at no latitude will there be fewer than three parallel communication channels. The IMPs were designed and developed from Honeywell 516 computers by Bolt Beranek and Newman, Inc. Nine IMPs are installed as of August 1, 1970. The lines are leased from the telephone common carriers, mainly the Bell System. All the installed IMPs are in continual communication with one another, testing, checking, and making records when not busy with actual messages, and it is evident from performance to date that the network will be able to handle about a trillion character-miles per day, day in and day out. Perhaps a more immediately meaningful measure is given by the approximately correct assumptions that there are typically three 50-kilobaud channels to or from a location and that a typical message will be relayed twice between source and destination. There will, according to those assumptions, be 15 locations, each with the capability of sending or receiving about one sixth of 20,000 characters a second, which amounts to about one typewritten page of text a second or, if the peak rate could be sustained, 86,000 typewritten pages of text a day.

Most of the 25 host computers of the ARPA Network are interactive time-shared computers. All together, they support about 1500 terminals, most still just teletypewriters but an increasing number equipped with cathode-ray-tube displays. The host computers are diverse in respect of manufacture, size, speed, language, and style of programming. Representatives of the several groups have been working together as a "Network Working Group" to define a standard communication protocol and to lay out specifications for the "network control programs" that will operate in the host computers and make it possible for remote users (people or programs) to "log in" and use the host's resources within limits set by the host's provisions for access control and (in due course) billing.

The ARPA Network will be used mainly to give research workers access to:

1. Computer programs or subprograms that have been prepared and tested in one computer environment but would be expensive and time-consuming to transfer to another.
2. Specialized computer hardware, such as the very fast and highly parallel processor, Illiac IV, currently under development, that would be prohibitively expensive to reproduce at many locations.
3. Remote or even geographically distributed files of data that are updated frequently.
4. Remote colleagues, together with programs and data, in geographically-separated-team research or in computer-supported "teleconferences."

There is not yet much research within the ARPA Network groups that is directly and specifically oriented toward library-information problems, but it is obvious that the network itself and the kinds of application envisioned for it have strong relevance to library-information networks.

In the present paradigm of the ARPA Network, the IMPs interface only with one another and with the host computer. All the consoles and all the data files in the network are associated directly with one or another of the host computers. In the future, however, there may be special "console computers," modified IMPs that connect arrays of consoles into the network but do not do substantial computing themselves, and "data computers," modified IMPs or specialized hosts that serve only the functions associated with data bases, do no substantial computing, and (perhaps even) have no consoles. Indeed, there will be experimentation with various equipment configurations and various specializations of function, some of which could well have direct bearing upon library-information applications.

When other networks begin to appear, interest will probably focus upon still other kinds of IMP, e.g., "multinetwork interfaces" to match host computers to several networks at once and "internetwork interfaces" to interconnect two or more networks for selected functions. If multinetwork and internetwork interfacing is handled properly, small networks will be able to join together or to attach themselves to large networks to serve certain functions without losing their individualities in respect of other functions.

For example, in the absence of legal and regulatory constraints, the internal networks of several pharmaceutical firms could remain separate insofar as proprietary information is concerned, yet join together to serve a nonproprietary pharmaceutical information system and at the same time link into a general library network, on the one hand, and a multi-airline reservation system, on the other -- not to mention their separate links to banks and to the digital text-communication system that will largely supplant the postal service insofar as interbusiness mail is concerned.

The thoughts of the preceding paragraph in one sense go far beyond the ARPA Network, yet in another sense they represent only obvious extensions of it. I think that they suggest fairly accurately the context within which library-information networks will evolve. There will be somewhat diverse but also somewhat compatible and interlocking computer-communication networks throughout business and government and, hopefully, also the educational and professional domains. Much of the stimulus toward compatibility and aggregation could and should come from the library-information sector.

A Library-Information Network Model for 1980

The generalization that most people overestimate what can be accomplished in one year and underestimate what can be accomplished in ten is, according to formula, a self-destructive generalization, but thus far it appears to remain true. Perhaps most people have not yet discovered it. I have discovered it, and I believe it, but the following model of a library-information network for 1980 nevertheless probably represents an underestimate. In an effort to make the model plausible, I shall no doubt scale down the aspiration level.

Nodes and Branches of the Network

The model assumes that in 1980 libraries and other components of the library-information system of the United States and several other countries are interconnected by an electronic nervous system of the kind described. The main centers, of which there are perhaps a thousand, are connected to one another by permanent channels (leased lines, microwave circuits, satellite links) more or less according to the ARPA Network paradigm. This library-information network is one of many extant networks, and, as suggested earlier, most of them are capable of interconnecting themselves selectively to serve broad and largely nonproprietary functions such as the library-information function. Subordinate centers are connected into the library-information network in many instances through main centers, but in many other instances several subordinate centers constitute a subordinate network and

share an IMP that is a node in the main network. Some of the communication channels are dial-up Dataphone channels. Some are Telex teletype channels. There is indeed considerable flexibility and great diversity in the pattern of approach to the main net, but at the same time economics serves as a driving force to get messages into the main net where the channels are wide, the traffic density is high, the accesses are quick, and the unit transmission costs are low.

Major libraries are of course conspicuously present in the list of main centers, about 50 libraries having IMPs (as well as host computers) of their own and some 250 using university or other organizational computers that are interfaced to IMPs. Most of the libraries that have or share IMPs and thus constitute major nodes of the network, however, are not major libraries. They are the libraries of organizations that are associated with the network primarily as users of information. There are about 600 of these organizations: business firms, nonprofits, government agencies, universities, international organizations, and (importantly) associations and consortia of various kinds. Most of the 600 organizations have internal computer-communication networks that serve several functions, the library-information function being an important one of the several. Because this multifunctional arrangement is the dominant one, only 10 or 15 percent of the cost of consoles and internal communication facilities -- over all -- is allocated to library information.

The remaining nodes of the main library-information network, approximately 100 in number, are associated with publishing houses, indexing and abstracting organizations, information analysis centers, organizations specializing in management of data bases, standards organizations, a few journals, and a few organizations concerned primarily with network research and development. Thus many of the organizations intensely involved in interaction with the body of knowledge have broad and direct channels of communication with one another and with the digital information resources of the network. Because of the prevalence of associations and consortia among the 1000 major "centers," far more than 1000 organizations are effectively "in the network" and "on line" to its computers. To illustrate this point with a specific example, I shall hypothesize -- without that organization's blessing but with hope that such a thing will come to pass -- that (in 1980) the Interuniversity Communications Council (EDUCOM) operates, as one of its services, a hierarchical network that brings 500 small-to-medium-size educational institutions into the library-information network through IMPs located at 30 major universities. The local and regional interconnections involve a complex of dial-up and leased facilities, EDUCOM-owned microwave links, state-owned microwave links and cable, and experimental satellite channels.

Functions of the Library-Information Network

The library-information network of 1980 is involved to a greater or lesser degree in almost every aspect of generating, publishing, organizing, preserving, retrieving, disseminating, and using the body of knowledge, but some of its functions are well established and widely exploited whereas others are still experimental or otherwise not yet cost effective. Among the main established functions are:

1. Distribution of papers, prior to publication, within what in the 1960's had been called "invisible colleges." (In 1980, such groupings are clearly visible in the records of computer-communication networks.) In the digitally advanced countries, most articles and reports are written and edited on-line. Almost nothing of less than 10-typewritten pages equivalent length is mailed within the United States.
2. Submission of papers to journal editors; reviewing and revision of papers.
3. Submission of programs and data sets to data-base editors; documentation, reviewing, revision, storage, organization, retrieval, and dissemination of programs and data sets.
4. Keeping bibliographic track of the status of all accessions (documents, programs, data sets,

films, and other forms -- including the emerging form here called "relational nets") to the corpus. One of the computer-processible data bases associated with the library-information network is a composite catalog that records each significant bibliographic fact and event (e.g., accepted for publication, published, stored in microimage form, filed in digital form, indexed, abstracted, reviewed) for every published entity.

5. Indexing and "descriptorizing" (and coordination of the indexing and "descriptorizing" performed by different agencies) of published entities. There are many indexes, catalogs, and directories within the network, prepared and maintained by diverse agencies, but with a fairly high degree of compatibility. (They are all computer processible. The basic incompatibilities that prevailed during early phases of the development of the network caused so much trouble that they had to be eliminated.) The organization of the indexes is hierarchical: there are indexes to indexes, etc. A study is being made of the feasibility and desirability of integrating all the indexes into one comprehensive index.

6. Abstracting of published entities.
   Abstracting is now (in 1980) being done mainly in a syntactically and lexically constrained form of natural language that can be processed and fairly deeply "understood" by computer. The new abstracts are compatible with relational nets and promise in due course to displace indexes based on descriptors in most selective retrieval and dissemination functions. Abstracting is performed mainly by the several large field-oriented abstracting services. Abstracts are maintained in computer-processible form in network data bases and searched mainly with the aid of proprietary search programs available (for a fee) through the network on an "execute-only" basis.
7. Current awareness services.
8. Retrospective search services.
9. Specialized bibliographic consultation and support. Inasmuch as the network makes it possible, given the knowhow, to exploit a vast array of sophisticated bibliographic techniques, entrepreneurial bibliographic consulting and support services have sprung up within the network, and many organizations

have hired librarians to work with users of information, e.g., as part of research teams.

10. Research on the organization of knowledge. The hottest research topic in the library field is relational nets. Most thesis problems in library science are concerned with transformations between natural language and relational nets, and most theses are full of rewrite rules, transition networks, and pointer structures.

11. Acquisition procedures and records. All the "paperwork" of ordering, receiving, paying, and so on is done through the network. In the larger libraries, much of the decision-making about what documents to acquire is done "by formula" -- i.e., by computer program. That procedure works fairly well because much information about each paper and film-based document is available prior to the time of its publication, because the selecting programs take many factors into account, and because much experience has been incorporated, over the years, into the programs.

12. "Circulation control." There is not much actual circulation anymore. What is called "circulation control" is actually execution of procedures concerned with copying, delivering copies, billing for copies, and paying

copyright fees. The largest single part of "circulation" is keeping track of the actual use of "videoform." Videoform is microform from the publisher to the using organization's library, then cable video to the individual who actually reads it from a screen with intrinsic storage without retrace yet with quick erase. Videoform requires much record keeping because the publisher is paid, not on the basis of the number of microform copies delivered to the using organization, but on the basis of the number of video copies actually displayed to a viewing individual.

13. Delivery of full text. Even though the library-information network of 1980 cannot handle the bulk of the document-delivery function, it is called upon to deliver large amounts of full text. Almost all documents newly acquired from organizational sources in the digitally advanced countries enter the publication system in digital form and are stored in that form in laser-beam or electron-beam storage devices. Such storage is compact and inexpensive. Even the processing, transmission, and display costs are affordable for high-priority access to short texts. The main drawbacks are that many old and many foreign documents do not exist in full-text

digital form, that only quite recently acquired charts, diagrams, and graphs are well encoded, that gray-scale and color photographs cannot yet be handled economically in digital code, and that there is still a shortage of transmission channels that severely limits the amount of retrospective full-text one can call for without a special priority. (As mentioned earlier, however, almost all business "mail" is transmitted digitally in the United States.)

14. Standardization. The network is of course a strong force toward standardization. As suggested earlier, incompatibility becomes untenable when it can be directly perceived to be the only remaining obstacle to a desired advance. Several working groups operate continually within the network in the overlapping areas of compatibility, standards, languages, formats, and protocol. All established standards are of course immediately available within the network, and there are programs that are fairly effective in monitoring compliance.

15. Record keeping. The network monitors itself and keeps records of its performance and of evaluations made by users.

16. Instruction in "how to use." The network of course provides instructions, part automated and part not, in use of the network.

17. Modeling the library-information system. In 1980, every system worthy of the name contains a model of itself, and the library-information system is no exception. The model is a sophisticated computer-program model. It incorporates the records of the use of the system that are accumulated by and through the network. An important aspect of the planning and research associated with the network involves varying the parameters -- and from time to time the structure -- of the model and studying the effects upon the model's performance.

How to Get from Here to There

As I see it, there are six elements that are vital to any plan for realizing the model described in the foregoing section or any other model essentially similar to it. The six vital elements are:

1. Successful completion and extension of the ARPA Network research and development program.
2. Participation by library and information scientists in research on and development of computer-communication networks such as the ARPA Network, or reliance upon one or more system contractors to learn the essentially pertinent things about libraries and information systems.
3. Mounting of a much stronger research and development effort than now exists in the field of library and information sciences. This effort should have strong bases in modern linguistics and computer science and technology.
4. Intensification of efforts in standards and related fields and orientation of those efforts toward networks.
5. Development of an over-all plan in terms of computer-program models. From the end of this conference onward, no one -- no individual, committee, commission, or company -- should be allowed to propose a project plan that is not cast in the form of a computer-program model.

6. Funding. There is no way to bring a library-information network into existence without subsidizing the research, development, and initial operating phases. I agree with the prevalent feeling that such a network should be self-supporting in mature operation, but I do not expect any leveling-off point that would clearly mark maturity to come in the next 20 years. I think that only a comprehensive model has any chance of handling the economic aspects of this question.

The foregoing six elements are of course not the only prerequisites for success. Help has to come from certain external sources over which library-information network planners have little or no control. The performance and cost trends of the computer technology must continue almost unchanged -- and that is asking a lot: an increase by a factor of approximately 30 in processing power, for example, in one decade. The performance and cost trends of the communication technology must not be any worse than they have been. The FCC must continue to encourage (or at any rate to allow) competition in information-processing parts of the computer-communication complex that come fairly close to the boundaries of the regulated natural-monopoly area -- e.g., the "modems" through which consoles are connected to telephone lines. And the Congress must resist the pressures of book publishers to protect the print-and-paper status quo with copyright legislation that would, for example, require one to pay a copyright fee before putting copyrighted information into a

computer-communication system, even if the probability were very low that anyone would ever ask to get it out. It is difficult to assess these four extrinsic factors, but I am more optimistic about them than about some of the six elements listed earlier.

Some Thoughts About Initial Steps

Participation in Network Research and Development

Psychologically the first question about an initial step is whether to take it ever, and the next question is whether to take it now. For myself, I can answer the first question in the affirmative without even deciding what the step should be, but about the second question I am uncertain. No doubt it is evident that I consider the ARPA Network to have a crucial importance for interactive computer-communication networks in general and thus for the library-information network under consideration here. I think it may take the ARPA Network two or three years to demonstrate its feasibility, economy, and effectiveness in several applications, and I suspect that there will be many skeptics in the interim and few thereafter. Why do I not therefore conclude that the library-information-network movement should simply cool it for two or three years, wait for the ARPA Network to prove or disprove itself, and jump on the bandwagon when and if the bandwagon starts to roll?

There are three reasons: (1) Problems of a library-information nature -- e.g., how to let users know what its resources are and how to exploit them -- are intrinsic to the ARPA Network, and ideas about how to solve them seem ripe and ready enough to contribute to the success of the ARPA Network.

(2) Two or three years from now may be too late for library-information people to influence significantly the development of computer-communication networks: the pattern will have been determined so predominately by considerations of programs and programming that the network may not be very hospitable, for example, to natural-language text and bibliographic data. (3) The library world has been on the whole somewhat laggard in adopting and exploiting modern information technology, and it would be very bad for it to drop two or three years further behind. For those reasons I strongly urge a few library and information people to get into the general-purpose interactive computer-communication game now.

A Plan in the Form of Computer-Program Models

In the present state of the nation and the world, I do not truly expect any massive response to a plea, even from a highly competent, widely respected, and quite powerful organization, for massive funding on a five- or ten-year basis for the purpose of turning a paper plan into a library-information network. Paper plans are no longer convincing. In the library-information field enough of them have accumulated to neutralize one another. Moreover, if they are detailed enough to be definitive, they are too long to read and, if read, too complex to understand. The idea of developing a comprehensive computer-program model of a proposed library-information network therefore appears to me greatly. Developing such a model -- an interactive multilevel simulation with a data base, a control language, graphical displays, and so on -- would greatly clarify many of the problems, and demonstrating it might convince the world that the planners had done their homework.

A Major Planning, Research, and Development Effort in Library-Information Systems

Except for the fact that the mood of the country is not conducive, all the factors seem ripe for a major effort of planning, research, and development in the library-information field. Modern information technology offers tremendous raw power, but it will have to be adapted before it will solve library-information problems. Almost everyone has now sensed the fact that there is an information flood -- if not explosion. There is at the top of the Establishment as much impatience about lack of progress toward a solution as ten years ago there was unawareness and unconcern. In short, the situation calls for a significant step -- a step that will get us off dead center -- but a safe and inexpensive one.

On that note, it seems to me, an immediate course of action shapes itself: Mount an effort to develop the computer-program model over a period of, say, three years. Combine that with carefully organized participation in network research and development. Choose a "neutral" lead organization to manage a summer study to get things organized. Pull representatives of all the major library and information organizations into the action. Set up a committee for each identifiable subproblem, not because committees are efficient but because interaction across the boundaries of established organizations is the essence of networking and prerequisite to the achievement of anything that can properly be called a system. Finally, be sure to make the effort multidisciplinary because the competencies required to develop a model

are scattered -- and be sure to make it informally international because knowledge is essentially international and because no formal international organization could complete a computer-program model in three years.

Abstract

Current advances in computer and communication technology are laying a foundation on which could be developed, during this decade, a library-information network that would serve as a central nervous system for the now only loosely coordinated components of the world's library and information complex -- that would speed them up, integrate them functionally, and increase the availability and effectiveness of their services to users. This paper describes the gross structure and main functions of such a network and makes suggestions about how to terminate (what the author perceives to be) the presently prevailing doldrum and get started on a course that will convert a major fraction of the potential into actuality. The paper tries to make it clear, however, that the network achievable by 1980 is in no sense the ultimate; indeed, it may represent an "awkward stage" in the long-term development of a new kind of knowledge system involving forms of representation superior to natural and mathematical languages and powerful contributions from artificial intelligence.